



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

July 16, 2019

SUBJECT: Perfluorooctane Sulfonate and Perfluorooctanoic Acid as a CERCLA Pollutant or Contaminant

FROM: *LB 8/20/19*
Lorie Baker, Region III NPL Coordinator

TO: Blades Groundwater Hazard Ranking System Documentation Record

The following memorandum discusses the qualifications for perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) as a "pollutant or contaminant" at the Blades Groundwater site according to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for the purposes of the HRS evaluation of the Blades Groundwater site. PFOS and PFOA were detected in the Town of Blades public water supply system, nearby domestic wells, and in a release documented in groundwater monitoring wells related to the Blades Groundwater site.

The HRS assigns an HRS site score based in part on hazardous substances at a site. The HRS Section 1.1, *Definitions*, defines hazardous substances for HRS purposes generally as including CERCLA hazardous substances and CERCLA pollutants or contaminants. CERCLA Section 101(33), defines a "pollutant or contaminant," stating:

The term 'pollutant or contaminant' shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organism or their offspring.

Longer chain perfluoroalkyl substances (PFASs), including PFOS and PFOA, are persistent, toxic, mobile, and bio-accumulative and can have a deleterious impact on human health and the environment. According to human epidemiology reports, PFOS and PFOA are associated with high cholesterol, increased liver enzymes, decreased vaccination response, thyroid disorders, pregnancy-induced hypertension and preeclampsia, gestational diabetes, and cancer (testicular, kidney, and liver). Further, it is not readily eliminated from the human body as evidenced by the half-life of 5.4 and 2.3 years for PFOS and PFOA, respectively (EPA publication, EPA 822-R-16-003, May 2016 and EPA publication, EPA 822-R-16-002, May 2016).

PFOS and PFOA are soluble in water and highly persistent in the environment (EPA publication, EPA 505-F-14-001, November 2014). To provide Americans, including the most sensitive populations, with a margin of protection from a life- time of exposure to PFOA and PFOS from drinking water, EPA established the health advisory levels at 0.07 micrograms per liter µg/l. When both PFOA and PFOS are found in drinking water, the combined concentrations of PFOA and PFOS should be compared with the 0.07 µg/l health advisory level. This

health advisory level offers a margin of protection for all Americans throughout their life from adverse health effects resulting from exposure to PFOA and PFOS in drinking water (EPA publication, EPA 800-F-16-003, November 2016). Combined PFOS and PFOA concentrations in the three Blades public supply wells exceed the EPA health advisory with combined concentrations of 0.08 µg/L, 0.159 µg/L, and 0.115 µg/L (See Reference 35 of the HRS documentation record). Additionally, combined PFOS and PFOA concentrations in three domestic drinking water wells exceed the EPA health advisory (Refs. 23, 24, and 26 of this HRS documentation record.).

Calculation of "Dose"

EPA's Risk Assessment Guidance for Superfund, Part B (1991) provides equations and exposure parameters and factors that represent Reasonable Maximum Exposure (RME) conditions for long-term/ chronic exposures to calculate preliminary remediation goals (PRGs). PRGs are developed to quantify the standards that remedial alternatives must meet in order to achieve threshold criteria developed in the National Contingency Plan for overall protection of human health. However, PRGs are only initial guidelines for scoping and do not establish clean up goals. Risk Assessment Guidance for Superfund, Part B uses the below equation to establish a residential water PRG for non-cancer effects. Exposure parameters are given in EPA's Exposure Factors Handbook, 2011 Edition and are further supplemented in OSWER Directive 9200.1-120.

$$C = \frac{THQ \times AT \times EDc \times BMc \times 1000 \frac{\mu g}{mg}}{EF \times EDc \left(\frac{1}{RfD} \right) \times IRWc}$$

Where:

C	= Water Concentration, Non-Carcinogenic (µg/L)
RfD	= Oral reference dose (in mg/kg-day)
AT	= Average time – resident (365 days/year)
BMc	= Body mass – child (= 15 kg)
EDc	= Exposure Duration – child (= 6 years)
EF	= Exposure Frequency – resident (= 350 days/year)
IRWc	= Drinking water ingestion rate – resident child (= 0.78 L/day)
THQ	= Target hazard quotient (= 1)

The above equation is modified to substitute "Dose" for the RfD. The resulting equation is:

$$C = \frac{THQ \times AT \times EDc \times BMc \times 1000 \frac{\mu g}{mg}}{EF \times EDc \left(\frac{1}{Dose} \right) \times IRWc}$$

Where:

Dose	= Oral dose (in mg/kg-day)
------	----------------------------

Using the exposure assumptions listed above, the equation can be simplified as:

$$C = 20054.95 \times Dose$$

Or

$$Dose = \frac{C}{20054.95}$$

EPA detected PFOS in monitoring wells in Blades, Delaware at concentrations up to 2.82 µg/L (See Reference 28, p.15 of the HRS documentation record). The calculated dose for 2.82 µg/L is 0.00014 mg/kg-day. In addition, EPA detected PFOS at concentrations up to 0.35 µg/L in a domestic drinking water sample (See Reference 23, p.42 of the HRS documentation record). The calculated dose for 0.35 µg/L is 0.000017 mg/kg-day.

EPA also detected PFOA in monitoring wells in Blades, Delaware at concentrations up to 0.610 µg/L (see Reference 34, p. 7 of this HRS documentation record). The calculated dose for 0.610 µg/L is 0.0000304 mg/kg-day.

Comparison of calculated "Dose" vs. PFOS oral reference dose (RfD) and PFOA oral reference does (RfD)

The Health Effects Support Documents for PFOS and PFOA establishes that an RfD is used as a benchmark for the prevention of long-term toxic effects other than carcinogenicity. The RfD determination assumes that thresholds exist for toxic effects, such as cellular necrosis, significant body or organ weight changes, blood disorders, and so forth. The RfD is expressed in terms of mg/kg-day. The RfD is an estimate (with uncertainties spanning perhaps an order of magnitude) of the daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime (EPA publication, EPA 822-R-16-002, May 2016 and EPA 822-R-16-003, May 2016).

The Health Effects Support Documents for PFOS and PFOA established an RfD value of 0.00002 mg/kg-day. The calculated PFOS dose in the monitoring well is 0.00014 mg/kg-day, which exceeds the RfD value. The calculated PFOS dose in the domestic drinking water sample is 0.000017 mg/kg-day, which is just below the RfD.

The calculated PFOS dose in a monitoring well is 0.00014 mg/kg-day and the calculated PFOA does in a monitoring well is 0.0000304 mg/kg-day, which exceeds the RfD values for PFOS and PFOA. Additionally, the calculated PFOS dose in a domestic drinking water sample is 0.000017 mg/kg-day, which is just below the RfD.

References

U.S. EPA. Exposure Factors Handbook: 2011 Edition. EPA/600/R-090/052F. Office of Research and Development, National Center for Environmental Assessment, Washington, DC, available at: <https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252>.

U.S. EPA. February 2014. Memorandum. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. Office of Solid Waste and Emergency Response, Washington, D.C, available at: https://epa-prgs.ornl.gov/radionuclides/EFH_changes_table_memo_2014.pdf.

U.S. EPA. March 2014. Emerging Contaminants – Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA). U.S. Environmental Protection Agency, Washington, DC, EPA EPA-505-F-14-001 Available at : <https://nepis.epa.gov/Exe/tiff2png.cgi/P100LTG6.PNG?-r+75+-g+7+D%3A%5CZYFILES%5CINDEX%20DATA%5C11THRU15%5CTIFF%5C00000916%5CP100LTG6.TIF>

U.S. EPA. Health Effects Support Document for Perfluorooactane Sulfonate (PFOS), U.S. Environmental Protection Agency, Washington, DC, EPA 822-R-16-002, May 2016, available at: https://www.epa.gov/sites/production/files/2016-05/documents/pfos_hesd_final_508.pdf

U.S. EPA. Health Effects Support Document for Perfluorooactanoic Acid (PFOA), U.S. Environmental Protection Agency, Washington, DC, EPA 822-R-16-003, May 2016, available at: https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_hesd_final_508.pdf

U.S. EPA. Fact Sheet PFOA & PFOS Drinking Water Health Advisories, U.S. Environmental Protection Agency, EPA 800-F-16-003, November 2016, available at: https://www.epa.gov/sites/production/files/2016-06/documents/drinkingwaterhealthadvisories_pfoa_pfos_updated_5.31.16.pdf

U.S. EPA. EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan, U.S. Environmental Protection Agency, Washington, DC, EPA 823R18004, February 2019, available at: https://www.epa.gov/sites/production/files/2019-02/documents/pfas_action_plan_021319_508compliant_1.pdf

U.S. EPA. Risk Assessment Guidance for Superfund (RAGS): Part B, available at: <https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-b>.

U.S. EPA. Hazard Ranking System (HRS; 40 CFR Part 300 Appendix A, 55 FR 51583), available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=09f19d9f8f4692bd034604e2fe4260a9&mc=true&node=ap40.30.300_11105.a&rqn=div9
<http://semspub.epa.gov/src/document/HQ/174028>
<https://www.regulations.gov/document?D=EPA-HQ-SFUND-2010-1086-0104>